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IMPROVED METHOD FOR PIV MEASUREMENT ON HIGH TEMPERATURE VITIATED SUPERSONIC FLOW-FIELD

Abstract

Obtaining the detailed flow-field information of scramjet combustor in simulated flight conditions is important for theory analysis of supersonic combustion and engineering application of hypersonic vehicle. In this paper, an improved PIV (Particle Image Velocimetry) technology for high temperature flow-field measurement was demonstrated experimentally. Considering the high temperature air was usually heated by vitiated combustion in ground test, the method with particle initially pre-mixing through air heater is recommended. In present research, three reactants, respectively air, pure oxygen and ethanol, were mixed and burned together. To ensure a uniformity distribution of trace particle in main-flow, a suspension with nano-scale particle TiO2 mixing into liquid ethanol was prepared in advance. The possibility and effectiveness were verified through experimental measurements through PIV system. Several typical flows commonly seen in supersonic flow-field, namely recirculation, oblique shock wave and flow chock due to combustion, were generally tested. The distribution of velocity vector of supersonic flow-field, affected by cavity, ramp and heat realease, were covered. What's more, based on current condition limited by camera exposure, two methods were suggested to solve the interfering problem of flame scatter light by combustion. It reveals that the method adopted in this paper was valid to acquire the main characteristics of supersonic flow-field and was especially suitable for application in large scale configuration with high temperature and high blowing speed.